Dependence of the Radio and Radar Spectra of Venus on Surface Conditions

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Kuzmin and Vetukhnovskaya (1968) suggest that ground pressures in the range from 20 to 70 atm satisfy the passive radio observations, but the higher pressure is necessary to provide a high opacity at $\lambda = 3.8$ cm and, therefore, to account for the low radar cross section observed at this wavelength. They point out that a surface pressure close to 70 atm need not contradict the Venera 4 observation of a surface pressure of 18.5 atm, if the capsule landed in a local region of high surface elevation, perhaps 10 km above the mean elevation.

As long as the ground temperature is fixed, however, and a roughly adiabatic lapse rate is assumed from the ground to the cloud tops, the radio brightness spectrum is rather sensitive to the ground pressure and seems to discriminate against the high surface pressure suggested by Kuzmin and Vetukhnovskaya. This is illustrated in the figure which shows the radio brightness of the planet (integrated over the disk) for several values of surface pressure P_0 and an adiabatic lapse rate (Ho *et al.*, 1966). The atmosphere is taken to consist of pure CO_2, and the dielectric constant of the ground, considered smooth at all wavelengths, is taken to be 5. All the atmospheric absorption is assumed due to induced absorption in CO_2.

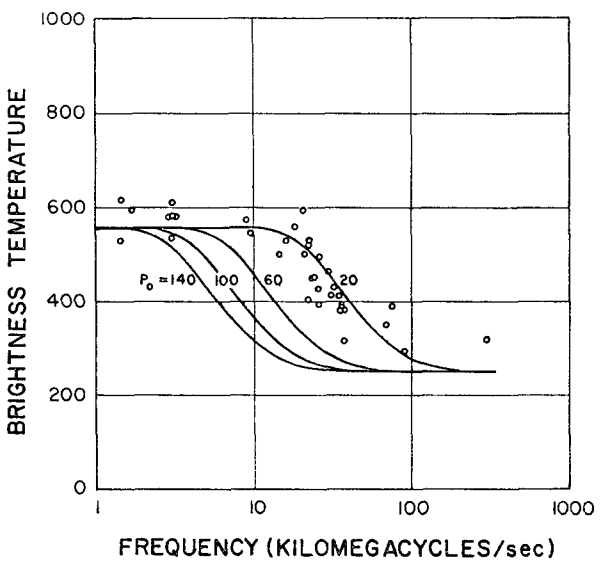

FIG. 1. Calculated values of radio brightness on Venus as a function of frequency, for indicated values of surface pressure. The circles represent observations.

It is interesting to note that if the temperature in the lower part of the atmosphere falls off very slowly with increasing altitude, it is possible to fit both the radar and radio observations with $P_0 \sim 70$ atm. The reason for this is that an approximately isothermal layer adds opacity to the atmosphere, but its contribution to the emitted radiation cannot be distinguished from that of the ground itself, as long as the ground is at the same temperature, and its emissivity is near unity. Two problems are associated with the use of such a model: first, it is still necessary to suppose that the Venera 4 capsule landed in the highlands in order to explain the 20-atm surface pressure observation; and second, this stagnant layer must be decoupled from the general circulation of the atmosphere to avoid heating which drives the lapse rate towards the adiabatic value.

REFERENCES

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